ZELLEROMYCES HISPANICUS SP. NOV. (RUSSULALES, ELASMOMYCETACEAE), AN ORANGE-RED SPECIES POSSIBLY RELATED TO *LACTARIUS AURANTIACUS*

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SUMMARY: *Zelleromyces hispanicus* is proposed and described as a new species, together with details on the ecology, morphology, anatomy and related taxa. The possible phylogenetic links with *Lactarius aurantiacus* are discussed.

KEY WORDS: Elasmomycetaceae, *Zelleromyces hispanicus*, taxonomy, ecology, Spain.

RESUMEN : Se describe *Zelleromyces hispanicus* como especie nueva para la ciencia y se aportan datos sobre su ecología, morfología y parentesco con especies próximas. Se propone una hipótesis sobre su posible relación filogenética con *Lactarius aurantiacus*.

PALABRAS CLAVE: Elasmomycetaceae, *Zelleromyces hispanicus*, taxomonía, ecología, España.

RÉSUMÉ : *Zelleromyces hispanicus* est proposé comme une espèce nouvelle, avec commentaires sur l'ecologie, morphologie et relations aux espèces alliées. Les possibles affinités phylogenetiques avec *Lactarius aurantiacus* sont discutés ici.

MOTS-CLÉS: Elasmomycetaceae, *Zelleromyces hispanicus*, taxonomie, ecologie, Espagne.

INTRODUCTION

The genus *Zelleromyces* was described by Singer & Smith (1960) as a member of the 'astrogastraceous series', now generally referred to as the gasteroid Russulales. It is characterized by astipitate gasterocarps, with an enclosed gleba, a laticiferous system producing latex and basidiospores which are both statismosporic and orthotropic with an amyloid ornamentation. It was based upon the type species *Z. cinnabarinus* Sing. & A. H. Sm., from Louisiana, U.S.A., and five other North American species were included in the original publication. Additional accounts by Beaton *et al.* (1984), Malençon (1975), Pegler & Young (1979) and Tao *et al.* (1993) have raised the number of species to around thirteen worldwide. Pegler & Young (1979) placed the genus in Elasmomycetaceae, separating it

from *Martellia* Mattir., on the basis of the production of latex, although the two genera are similar in other respects, each include species with spores having either ■ reticulate or spinose ornamentation. Subsequently Beaton *et al.* (1984) restricted *Zelleromyces* to the reticulate-spored species.

The genus has not hitherto been recorded from Spain, so that the following account represents the first record for the country. The collections studied have been deposited in Madrid (MA-Fungi) and Kew (K).

DESCRIPTION

Zelleromyces hispanicus Calonge & Pegler, sp. nov.

Gasterocarpus 2-5 cm latus, subglobosus vel lobatus, tuberoideus, sessilis, ad basim depressus. Peridium alutaceis, laeve, glabrum. Latex albidus. Gleba pallide aurantiaca, in sicco rosea alutacea, loculis irregulariter dispersitis. Columella nulla vel rudimentaria. Sporae statismosporicae, orthotropicae, 9-12 (-14) × 8-10 µm, subglobosae vel late ovoideae, hyalinae, tenuitunicatae, grosse reticulatae amyloideae, basidia 25-35 × 5-12 µm, cylindrico-clavata, 2- vel 4- sporigera. Cystidia 20-40 × 8-10 µm, lageniformia. Trama hymenophoralis cum hyphae afibulatae, hyalinae, elementis laticiferis instructa; sphaerocytis carens. Peridiopellis pseudoparenchymatica.

Madrid, Cercedilla, Dehesas, subhypogeus, subter Pinus sylvestris, 27-XI- 1996, legit F. D. Calonge & C. Garcia Ruz. MA-Fungi 37498 (holotypus); K(M) 54685.

Gasterocarp sessile, subhypogeous, 2-5 cm diam., tuberoid, globose to ellipsoid, with a depressed base surrounding the point of attachment. Peridium smooth, matt, orange when fresh drying reddish brown. *Gleba* pale cream drying yellowish pink, labyrinthoid; latex present, whitish, unchanging. *Gleba*l *locules* irregularly arranged, partially filled. *Columella* absent or rudimentary; *stipe* absent; *sterile base* poorly developed. *Odour* aromatic; *taste* sweetish, astringent to somewhat hot. *Peridiopellis* very thin, 100-200 µm thick, made of two layers: the outer one pseudoparenchymatous, with isodiametric elements, 10-20 µm diam. with brownish vacuolar pigment; some crystals and residual soil debris are also observed (fig.1a). Inner layer made of gelatinizing, agglutinated hyphae, hyaline, septate and clampless (fig. 1b). *Basidia* 25-35 × 5-12 µm, cylindrico-clavate, 2-4 sterigmata 5-8 µm long (fig. 2a). *Basidiospores* 9-12 (-14) × 8-10 µm, including reticulum, subglobose to broadly ovoid, hyaline, with an ornamentation of continuous or interrupted ridges forming an incomplete reticulum, overlaid strongly amyloid myxosporium (figs. 3-4). *Sphaerocytes* absent. *Cystidia* present, proyecting beyond hymenial elements, 20-40 × 8-10 um, lageniform, hyaline, thin-walled, with guttulate bodies irregular in size (fig. 2b). *Laticiferous elements* present 2-8 µm diam., vermiform, aseptate, branching, thin-walled, with strongly refractive yellowish amber contents, scattered throughout the hymenophoral tramal plates (fig. 1c). *Hymenophoral trama* made of hyaline hyphae, 3-6 µm diam., thin-walled, branching, septate, clampless (fig. 1d).

Specimens examined: Spain, Madrid, Cercedilla, Dehesas, in granitic soil under *Pinus sylvestris*, also with associated scattered bushes of *Adenocarpus, Citisus, Crataegus, Rosa, Rubus* and abundant basidiomata of *Lactarius aurantiacus*; 27-XI-1996, coll. F. D. Calonge & C. Garcia Ruz, MA-Fungi 37498 (holotype), K(M)54685; 23-XI-1996, coll. J.

Daniel & J. M. Santos, MA-Fungi 37497, K(M)54685; 16-XI-1997, coll. R. Cifuentes, MA-Fungi 38311.

DISCUSSION

The genus *Zelleromyces* demonstrates a cosmopolitan distribution, at least as far as the temperate-subtropical regions are concerned. The species, however, tend to be localised. The only European species hitherto described, *Z. stephensii* (Berk.) A. H. Sm., is only rarely found, but is known from the Czech Republic, England (type locality), France, Germany, Italy and Switzerland. The bright orange to reddish brown colouration of the peridium strongly suggests the present species but the spore ornamentation is consistently verrucose to spinose, and lacking any reticulation. Other red species include *Z. josserandii* Malençon, from Morocco with a brick red to tawny red peridium and, like *Z. hispanicus*, is associated with *Pinus* (also *Cedrus* and *Fagus*) but the subreticulate spores are significantly smaller, 8.6-11 × 7.2-8.6 µm, cystidia are lacking and the peridiopellis is a subepithelium. In North America, *Z. gardneri* (Zeller & Dodge) Singer & A.H. Sm., from California, and *Z. ravenelii* (Berk. & M. A. Curtis) Singer. & A. H. Sm., from the eastern United States, are similar in many features but have cream-coloured to brown gasterocarps. *Zelleromyces daucinus* Beaton, Pegler & Young, from Victoria State, Australia, is a carrot red species but has smaller spores, lacks cystidia and has an epithelial peridiopellis. Perhaps, the type species, *Z. cinnabarinus* Singer. & A. H. Sm., from Louisiana, U. S. A., most closely approaches to *Z. hispanicus*, having a cinnabar red gasterocarp, spores of comparable size, range and ornamentation, and the development of hymenial cystidia, but sphaerocytes are present and the peridiopellis is subepithelial.

Zelleromyces hispanicus differs from all the above species most noticeably in the complete absent of sphaerocytes, both in the peridiopellis and in the context giving a homoiomerous structure, yet the laticiferous system, the latex, and the amyloidity of the spores indicates the species is correctly placed amongst the genera of the Russulales, within the family Elasmomycetacae.

Hydnangium aurantiacum R. Heim & Malençon was described (Heim *et al.*, 1934) as a subhypogeous fungus from Montserrat, north of Barcelona, in the Catalan region of Spain. The yellowish orange pigmentation of the peridium suggested to these authors a relationships with *Stephanospora carotaecolor* (Berk. & Br.) Pat. Following an extensive search , the type collection of *H. aurantiacum* was located at Paris (PC) and it has been possible to make a comparison with *Z. hispanicus*. The peridiopellis is pseudoprosenchymatous, very thin, 20-50 µm thick, discontinuous or lacking, the basidiospores do not have an amyloid myxosporium, as originally described, and the short, truncate cusporial ridges remain isolated and do not anastomose. Combining the characteristics of the spore with the additional micro-characters of the presence of clamp-connexions and the absence of laticiferous hyphae, eliminates *H. aurantiacum* from both, Elasmomycetaceae and Russulales. Svrcek (1958) placed *H. aurantiacum* within *Octaviania* Vittad. (= *Octavianina* Kuntze), but the nature of the spore ornament precludes this possibility. Heim *et al.*(1934) were probably correct in comparing the species with *Stephanospora* Pat. (Stephanosporaceae Oberw. & E. Horak), even though the basidiospore lacks the peri-appendicular corolla found in *S. carotaecolor*. Comparison can be made with *S. flava* (Rodway) Trappe & Pfister from Tasmania and Australia; *S. penangensis* Corner &

Hawker from Malaysia and *S. redolens* (G. Cunn.) E. Horak from New Zealand, all of which have spores lacking a corolla.

Growing in close proximity to the *Zelleromyces* gasterocarps were large numbers of the agaricoid species, *Lactarius aurantiacus* (Pers.: Fr.) Gray, with similar orange to tawny pigmentation. Further similarities in the structure of the pileipellis, the latex and laticiferous system, and the presence of lageniform cystidia could suggest that there may be a close relationship between the two species. There are marked differences in spore form, however, which may be due to the ballistospory or otherwise of the two species. In *Z. hispanicus* the spore are truly statismosporic in form, radially symmetrical, lacking a suprahilar plage and larger. *Lactarius aurantiacus* spores, on the other hand, are typically ballistosporic in form, bilaterally symmetrical, with an applanate, inamyloid suprahilar plage, and measuring 7-11x 6-9 µm (figs. 5-6). It remains to be determined whether or not the two species are phyletically linked.

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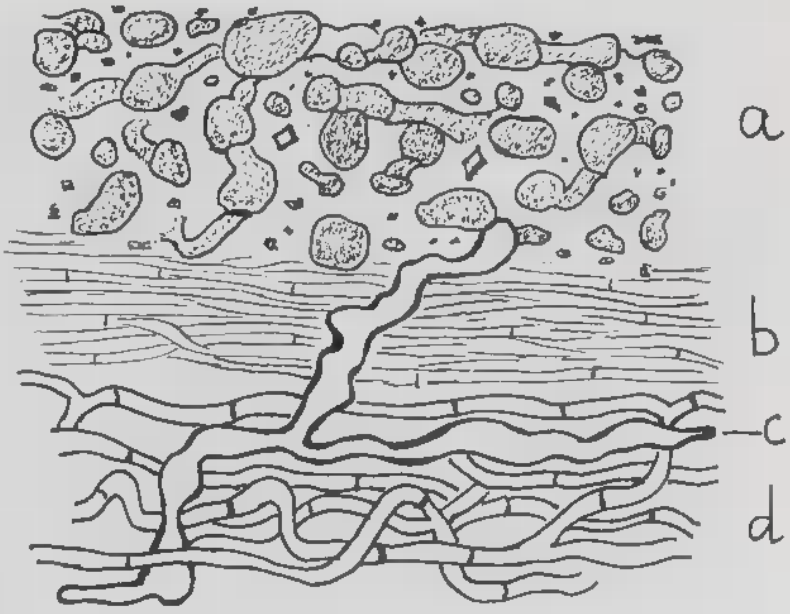

Fig. 1. *Zelleromyces hispanicus* (MA-Fungi 37498, holotype). Diagram of peridial, context and hymenophoral trama anatomy: *a*, pseudoparenchymatous peridiopellis with, vacuolar pigment; *b*, context of hyaline, gelatinized hyphae; *c*, laticiferous element; *d*, hymenophoral trama with septate hyphae lacking clamp-connexions.

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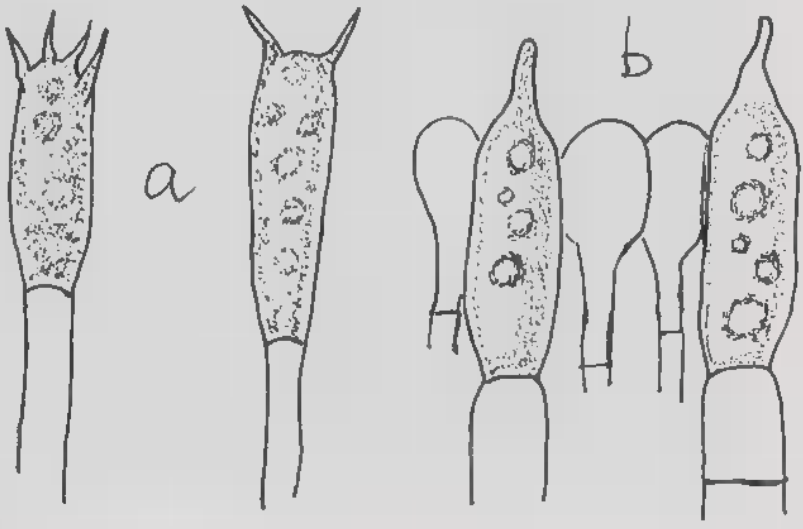
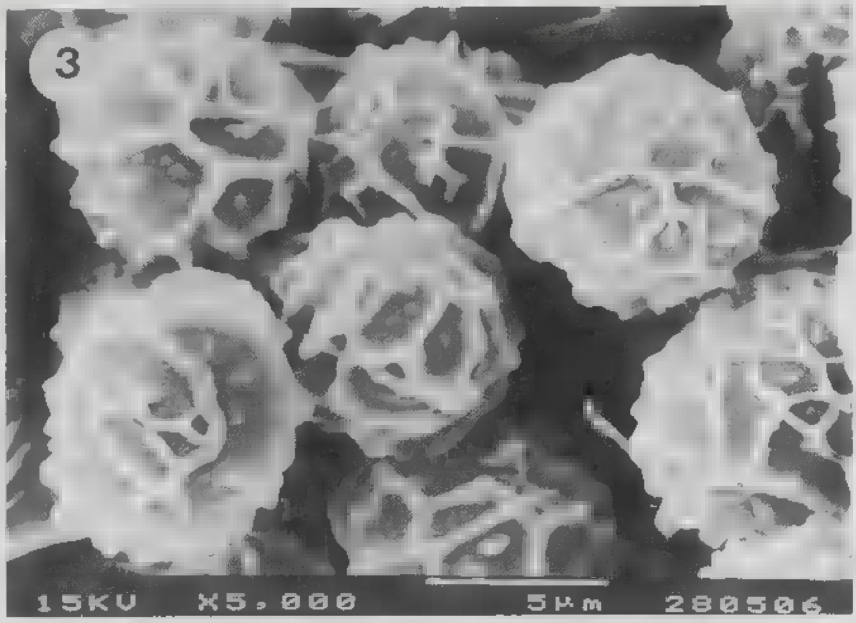
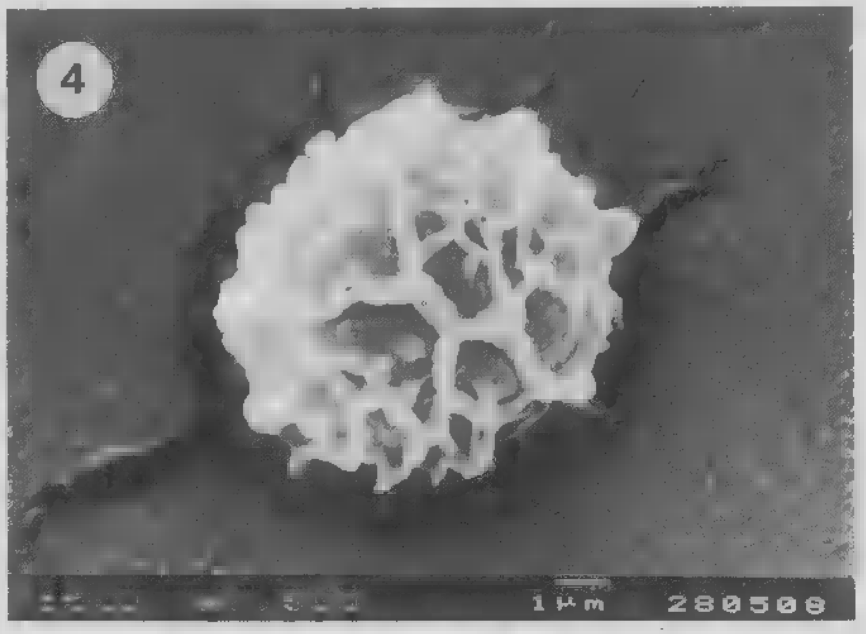
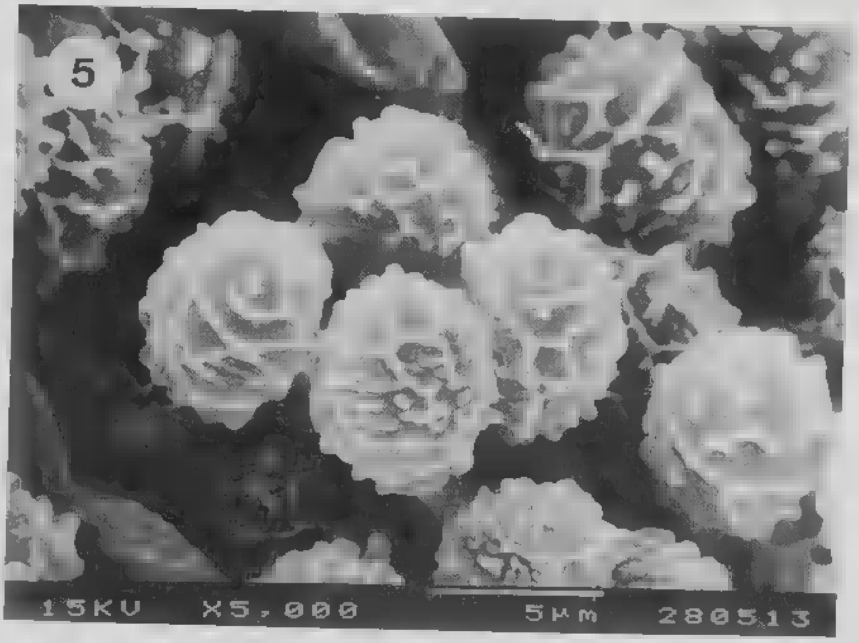


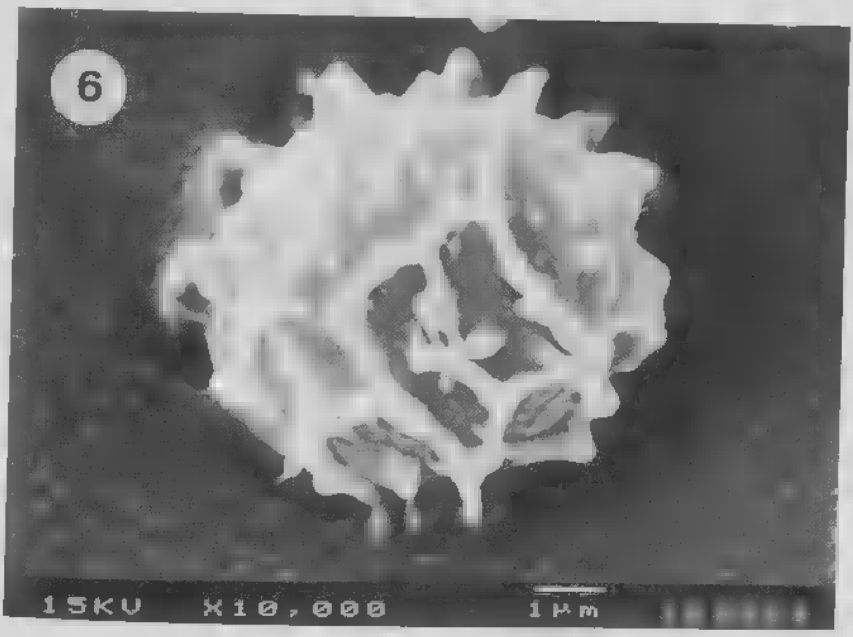
Fig. 2. *Zelleromyces hispanicus* (MA-Fungi 37498, holotype). *a*, bi — and tetrasporic basidia; *b*, projecting, lageniform hymenial cystidia.





Figs. 3-4. *Zelleromyces hispanicus* (MA-Fungi 37498, holotype), basidiospores.





Figs. 5-6. *Lactarius aurantiacus* (MA-Fungi 37499), basidiospores.